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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte DAWN WHITE and
DAVID CARMEIN

Appeal 2008-4487
Application 10/629,285
Technology Center 1700

Decided: September 16, 2008

Before TERRY J. OWENS, PETER F. KRATZ, and
MICHAEL P. COLAIANNI, *Administrative Patent Judges*.

COLAIANNI, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134 the final rejection of claims 1-11 and 23-27. We have jurisdiction over the appeal pursuant to 35 U.S.C. § 6(b).

We AFFIRM.

INTRODUCTION

Appellants claim a method of fabricating a thermal management device comprising the steps of using a solid-state consolidation process to

deposit a plurality of first material layers exhibiting a high degree of thermal conductivity, and separating the first material layers with a different, second material having a desired physical property (claim 1). Appellants disclose that using the solid-state additive manufacturing techniques are attractive for producing heat sinks because molding of the parts via liquid phase techniques may be expensive or difficult, and the solid-state processes have higher deposit rates than those involving liquid phase bonding and may be scaled up more easily (Spec. 3).

Claims 1 and 9-11 are illustrative:

1. A method of fabricating a thermal management device, comprising the steps of:

a) using a solid-state consolidation process to deposit a plurality of first material layers exhibiting a high degree of thermal conductivity; and

b) separating the first material layers with a different, second material having a desired physical property.

9. The method of claim 1, wherein the solid-state consolidation process is an ultrasonic consolidation process.

10. The method of claim 1, wherein the solid-state consolidation process include electrical resistance consolidation.

11. The method of claim 1, wherein the solid-state consolidation process includes frictional consolidation.

The Examiner relies on the following prior art references as evidence of unpatentability:

Trenkler	4,885,214	Dec. 5, 1989
Reddy	5,792,677	Aug. 11, 1998
Dorfman	6,103,392	Aug. 15, 2000

The rejections as presented by the Examiner are as follows:

1. Claims 1-8, and 23-27 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reddy in view of Dorfman.
2. Claims 9-11 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reddy in view of Dorfman and Trenkler

With regard to the first rejection, Appellants separately argue claim 1 only. Accordingly, we address Appellants' arguments with regard to that rejection with respect to claim 1 only; claims 2-8, and 23-27 stand or fall with claim 1.

With regard to the second rejection, Appellants argue claims 9-11 separately. Accordingly, we address Appellants' arguments regarding the second rejection with respect to claims 9-11.

OPINION

35 U.S.C. § 103 REJECTION OVER REDDY IN VIEW OF DORFMAN

Appellants argue that the Examiner improperly bases the obviousness conclusion on "conclusory statements" (Br. 4). Appellants contend that Dorfman does not mention "solid state consolidation" or depositing "layers" as claimed (Br. 5).

We have considered Appellants' arguments and are unpersuaded for the reasons below.

The Examiner finds that Reddy discloses every feature of claim 1, except the solid-state consolidation process (Ans. 3). The Examiner finds that Dorfman discloses sintering or consolidating metal materials into desired shapes (Ans. 3). Based on these findings, the Examiner concludes that it would have been obvious to use Dorfman's consolidation process to

form Reddy's metal plates in order to fabricate the metal layers with desired shapes (Ans. 6). We agree.

We begin our analysis by construing Appellants' claim 1. Claim 1 recites "using a solid-state consolidation process to deposit a plurality of first material layers exhibiting a high degree of thermal conductivity" and "separating the first material layers with a different, second material having a desired physical property" (claim 1). Appellants do not define the claim phrase "solid-state consolidation." However, Appellants' Specification broadly discloses that solid-state consolidation techniques include those "described in commonly assigned patents and copending applications, or other appropriate or yet-to-be-developed approaches" (Spec. 3-4). Appellants further indicate that copending application 10/088,040 (now U.S. Patent 6,814,823 B1), describes suitable ultrasonic, electrical resistance, and frictional methodologies for solid-state consolidation (Spec. 4). These disclosures do not limit "solid-state consolidation" to any particular meaning. Based on these disclosures, we construe "solid-state consolidation" as including depositing a layer of solid material (e.g., particles) and applying energy to consolidate (e.g., bond or sinter) the solid material layer together into an integral object.

We further construe claim 1 as only requiring the first material layers to be made by a solid-state consolidation process. The claim does not require that the second material be made by a solid-state consolidation process.

Reddy discloses a thermal management device for electronic circuits that includes metal planes embedded in an insulating, plastic matrix

(Reddy, col. 1, ll. 5-7; col. 4, ll. 48-57). Reddy discloses that the metal planes function as a heat sink for removing the heat produced by electronic devices (Reddy, col. 4, ll. 52-54). The metal planes are constructed of a "highly conductive material, such as silver, aluminum copper or the like" (Reddy, col. 4, ll. 50-52). Reddy discloses that the metal plane and plastic structure may be made by "insert molding or any other suitable process" (Reddy, col. 6, ll. 62-67). Reddy discloses that the insulating substrate is formed around the metal planes during the molding step (Reddy, col. 6, ll. 62-67).

Dorfman discloses a tungsten-copper composite powder useful for forming sintered articles having a high degree of dimensional control (Dorfman, col. 2, ll. 1-4). Dorfman discloses that the tungsten-copper pseudoalloys are used to make thermal management devices such as heat sinks in electronic devices (Dorfman, col. 1, ll. 13-15; col. 14, ll. 55-60). Dorfman discloses that the tungsten-copper powders undergo "solid-state" sintering (i.e., consolidating) (Dorfman, col. 3, ll. 4-27). Dorfman further discloses that sintering is the basic property which controls powder consolidation (Dorfman, col. 13, ll. 4-5). Dorfman discloses that the tungsten-copper powder has a high electrical and thermal conductivity (Dorfman, col. 1, ll. 61-64; col. 12, ll. 55-57). Dorfman further discloses reducing the rate of temperature increase during the solid-state sintering stage avoids undesirable copper bleed out of the tungsten-copper alloy (Dorfman, col. 14, ll. 22-24).

Based on these disclosures and our claim construction, we agree with the Examiner that it would have been obvious to use Dorfman's solid-state consolidation process to form tungsten-copper metal planes for use in

Reddy's method of making a thermal management device for electronic devices. Dorfman's disclosures that tungsten-copper is used to form heat sinks for electronic devices, has excellent electrical and thermal conductivity, and solid-state sintering is used to form objects from the tungsten-copper powder support using the solid-state consolidation (i.e., sintering) process to form Reddy's metal plane heat sinks for use in electronic devices. Notably, Reddy does not restrict the particular type of forming method for the metal planes.

Contrary to Appellants' argument, Dorfman discloses that the tungsten-copper powder undergoes solid-state sintering, which consolidates the powder into a finished article (Dorfman, col. 2, ll. 1-4; col. 11, ll. 54-55; col. 14, ll. 17-24). The Examiner also finds that Dorfman's solid-state sintering is synonymous with consolidating (Ans. 3), which finding is not rebutted by Appellants. In other words, we find that Dorfman discloses a "solid-state consolidation process" within the broad meaning given to that claim phrase by Appellants in the Specification.

Regarding the argued "layers" claim feature, the teachings of Dorfman and Reddy together would have suggested the claim feature. Specifically, Dorfman discloses that the tungsten-copper powder may be formed into "sintered articles" without specifying a particular shape (Dorfman, col. 2, ll. 1-4). Reddy discloses using metal planes that are pre-shaped (i.e., flat metal plates) to make the thermal management device (Reddy, col. 6, ll. 65-67; col. 8, ll. 16-22). Accordingly, the teachings of Reddy and Dorfman, taken as a whole, would have suggested to one of ordinary skill in the art to deposit and consolidate Dorfman's tungsten-copper powder into metal planes (i.e., "layers") for use in making Reddy's

thermal management device for electronic devices. Once incorporated into Reddy's device, the plurality of metal planes (i.e., layers) would be separated by Reddy's insulating substrate layers (i.e., the second material having a desired physical property). Our determination that Reddy's metal planes may reasonably be considered "layers" is consistent with Appellants' Specification that indicates that metal "foil" or "woven or unwoven mesh" may be considered a "layer" (Spec. 4).

In light of the foregoing, we determine that the Examiner's obviousness analysis is not based on conclusory statements, but, rather, the teachings and suggestions of the prior art. Accordingly, we determine that the Examiner has established a prima facie case of obviousness. Appellants have not provided any persuasive argument or evidence of secondary considerations (e.g., unexpected results) to rebut the Examiner's prima facie case.

Accordingly, we sustain the Examiner's § 103 rejection of claims 1-8, and 23-27 over Reddy in view of Dorfman.

35 U.S.C. § 103 REJECTION OVER REDDY IN VIEW OF DORFMAN AND TRENKLER

Appellants argue that Trenkler does not teach or suggest an ultrasonic (claim 9), electrical resistance (claim 10), or frictional (claim 11) consolidation process (Br. 6). Appellants contend that Trenkler does not suggest how such consolidation processes may be used to deposit layers, such that the combination of Reddy, Dorfman and Trenkler fail to teach all of the claim features (Br. 6). Appellants contend that the Examiner's determination that an electrical resistance or a friction solid-state consolidation process is a functional equivalent alternate expedient in the art,

is not substantiated by any teaching or suggestion from the art and is based on improper hindsight (Br. 6-7).

Reddy's and Dorfman's disclosures are noted above in our discussion of the § 103 rejection over Reddy in view of Dorfman. Trenkler discloses a composite material having improved thermal expansion and conductivity (Trenkler, col. 1, ll. 10-12). Trenkler discloses, for example, forming a composite of wire and metal powders, compacting the mixture, and subjecting the compacted article to heat treatment or other means of energy insertion like ultrasonic vibration, inductive heating, or magnetic energy for sintering and diffusion-bonding the particles of metal powder and wire together (Trenkler, col. 6, ll. 5-24). Trenkler discloses that the powder metal matrix may be aluminum, copper, or other metals (Trenkler, col. 6, ll. 56-57). Trenkler also discloses that the discrete portions (e.g., wire) may be tungsten, stainless steel, molybdenum, or other nickel or iron-based material (Trenkler, col. 6, ll. 52-56).

These disclosures indicate that Trenkler and Dorfman form composite bodies based on powdered or comminuted materials that are sintered together. Accordingly, we agree with the Examiner that it would have been obvious to modify the method of making a thermal management device for electronic devices as taught by Reddy in view of Dorfman by using Trenkler's ultrasonic vibration technique to sinter together the powdered or comminuted materials because such a technique produces a high strength product (Trenkler, col. 6, ll. 26-27).

We are unpersuaded by Appellants' argument that Trenkler does not disclose how the solid-state consolidation process "deposits" a layer. Appellants' Specification does not describe what is meant by depositing a

layer. In fact, the examples provided by Appellants' Specification indicate that depositing merely includes providing preformed metal foil or woven-mesh layers, which are subsequently consolidated (Spec. 4). In other words, it appears from Appellants' Specification that "deposit" includes providing a stack of preformed metal foil layers, which are subsequently, consolidated using the solid-state consolidation technique. Accordingly, we agree with the Examiner that Trenkler's ultrasonic consolidation, for example, would consolidate (i.e., sinter) the deposited powder materials (i.e., preformed metal particles) so as to form a layer of consolidated metal particles for use as the metal plane in the thermal management device of Reddy in view Dorfman. The multiple metal planes in Reddy's thermal management device made by using the solid-state consolidation process constitute "layers" as determined above in our discussion of the Reddy in view of Dorfman rejection. This broad construction is reasonable in view of Appellants' Specification and their failure to adequately define the claim phrase, "using a solid state consolidation process to deposit a plurality of layers."

With regard to claims 9-11, we find that Appellants have not defined what is meant by "electrical resistance consolidation" or "frictional consolidation." Rather, Appellants refer to copending U.S. Patent Application 10/088,040, now U.S. Patent 6,814,823 B1, to describe "ultrasonic, electrical resistance, and frictional methodologies" (Spec. 4). U.S. Patent 6,814,823 describes that "frictional" consolidation includes using ultrasonic energy to create friction at the interface of the layer to form the joint (col. 16, ll. 20-29). Accordingly, we construe Appellants' "frictional consolidation" of claim 11 as including ultrasonic consolidation. Moreover, U.S. Patent 6,814,823 discloses frictional consolidation includes

ultrasonic consolidation, which supports the Examiner's determination that ultrasonic consolidation and frictional consolidation are functional equivalents. Therefore, for the above reasons, we determine that claims 9 and 11 would have been obvious over Reddy in view of Dorfman and Trenkler.

We determine that Appellants' hindsight argument regarding the frictional consolidation process is unpersuasive because Trenkler discloses using ultrasonic consolidation. Appellants disclose that ultrasonic consolidation is a type of frictional consolidation process in U.S. Patent 6,814,823 (Spec. 4) within the meaning of claim 11. Accordingly, the obviousness conclusion regarding the frictional consolidation process is based on the teachings of the prior art, not impermissible hindsight.

With regard to "electrical resistance consolidation," U.S. Patent 6,814,823 generally describes passing a direct current through the layers to be consolidated using an "indirect welding situation" as shown in Figure 18 of the patent. The "indirect welding situation" uses a positive and negative electrode positioned on the same side of the layers and applying a resistance current to the layers to join the layers together (6,814,823 Figure 18).

The Examiner contends that electrical resistance consolidation is a functional equivalent to the ultrasonic, magnetic energy, or inductive consolidation disclosed by Trenkler. We agree. In our view, the inductive heating disclosed by Trenkler inherently includes inducing currents within deposited layers to consolidate the layers. In other words, Trenkler's inductive heating functions in the same manner as Appellants' disclosed electrical resistance heating by creating currents within the material to consolidate it. Accordingly, we determine that the teachings of Reddy,

Dorfman, and Trenkler taken as a whole would have suggested the claimed electrical resistance heating. We sustain the Examiner's § 103 rejection of claim 10 over Reddy in view of Dorfman and Trenkler.

DECISION

We sustain the § 103 rejection of claims 1-8, and 23-27over Reddy in view of Dorfman.

We sustain the § 103 rejection of claims 9-11 over Reddy in view of Dorfman and Trenkler.

The Examiner's decision is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

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